PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 14 June 2000 (14.06.00)	
International application No. PCT/SG99/00103	**Applicant's or agent's file reference** SS/CK/556/98
International filing date (day/month/year) 22 October 1999 (22.10.99)	**Priority date** (day/month/year) 27 October 1998 (27.10.98)
Applicant POSTON, David et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

18 May 2000 (18.05.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

BEST AVAILABLE COPY

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Pascal Piriou

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:

Tan, Rajah & Cheah
9 Battery Road #15-00
Straits Trade Building
Singapore 049910

PCT/PCT Rec'd 26 APR 2001

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

	Date of mailing *(day/month/year)* -7 DEC 1999
Applicant's or agent's file reference SS/CK/556/98	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. **PCT/SG 99/00103**	International filing date 22 October 1999
Applicant National University of Singapore (et al.)	

1. [X] The applicant is hereby notified that the international search report has been established and is transmitted herewith

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the international search report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau.

If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later)

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **P. CLAYTON-STAMM** Telephone No. (02) 6283 2168

(See notes on accompanying sheet)

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under Article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule" and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasised that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, eg. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Preliminary Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

(i) the claim is unchanged:
(ii) the claim is cancelled;
(iii) the claim is new;
(iv) the claim replaces one or more claims as filed;
(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."

2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."

3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."

4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under Article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequences if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments and any accompanying statement, under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the time of filing the amendments (and any statement) with the International Bureau, also file with the International Preliminary Examining Authority a copy of such amendments (and of any statement) and, where required, a translation of such amendments for the procedure before that Authority (see Rules 55.3(a) and 62.2, first sentence). For further information, see the Notes to the demand form (PCT/IPEA/401).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see the *PCT Applicants Guide*, Volume II.

PCT/PCT Receipt ... R 2001

TENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference SS/CK/556/98	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. **PCT/SG99/00103**	International filing date *(day/month/year)* 22 October 1999	Priority Date *(day/month/year)* 27 October 1998
International Patent Classification (IPC) or national classification and IPC **Int. Cl.** [7] G06F 17/00		
Applicant JOHN HOPKINS SINGAPORE PTE LTD		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheet(s).

3. This report contains indications relating to the following items:

I	☒	Basis of the report
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☐	Certain defects in the international application
VIII	☐	Certain observations on the international application

Date of submission of the demand 18 May 2000	Date of completion of the report 24 May 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **J.W. THOMSON** Telephone No. (02) 6283 2214

INTERNATIONAL PRELIM[redacted]RY EXAMINATION REPORT

[redacted]rnational application No.
PCT/SG99/00103

I. Basis of the report

1. With regard to the **elements** of the international application:*

[X] the international application as originally filed.

[ ] the description, pages , as originally filed,
pages , filed with the demand,
pages , received on with the letter of

[ ] the claims, pages , as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages , received on with the letter of

[ ] the drawings, pages , as originally filed,
pages , filed with the demand,
pages , received on with the letter of

[ ] the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. [ ] The amendments have resulted in the cancellation of:

[ ] the description, pages

[ ] the claims, Nos.

[ ] the drawings, sheets/fig.

5. [ ] This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1 - 24	YES
	Claims		NO
Inventive step (IS)	Claims	1 - 24	YES
	Claims		NO
Industrial applicability (IA)	Claims	1 - 24	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

US 5623418

US 5544352

US 4672683

None of these citations discloses the invention as defined in claims 1 to 24.

WO 00/25229
PCT/SG99/00103

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PRIORITY DOCUMENT 2001

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
SACHITHANANTHAN, Suresan
Tan, Rajah & Cheah
Straits Trading Building
9 Battery Road #15-00
Singapore 049910
SINGAPOUR

Date of mailing (day/month/year) 04 May 2000 (04.05.00)	
Applicant's or agent's file reference SS/CK/556/98	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/SG99/00103	22 October 1999 (22.10.99)	27 October 1998 (27.10.98)

Applicant
JOHNS HOPKINS SINGAPORE PTE LTD et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,JP,KP,KR,MA,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   04 May 2000 (04.05.00) under No. WO 00/25229

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

PTO/PCT Rec'd 26 APR 2001

PATENT COOPERATION TREATY

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Tan, Rajah & Cheah
9 Battery Road #15-00
Straits Trade Building
Singapore 049910

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing (day/month/year): 05 JUL 2000

Applicant's or agent's file reference: SS/CK/556/98

IMPORTANT NOTIFICATION

International application No.	International filing date	Priority date
PCT/SG99/00103	22 October 1999	27 October 1998

Applicant: JOHN HOPKINS SINGAPORE PTE LTD

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translations to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices)(Article 39(1))(see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide

Name and mailing address of the IPEA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
Facsimile No. (02) 6285 3929

Authorized officer

J.W. THOMSON

Telephone No. (02) 6283 2214

PATENT COOPERATION TREATY

PCT

PTO/PCT Rec'd 26 APR 2001

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference SS/CK/556/98	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/SG 99/00103	International filing date *(day/month/year)* 22 October 1999	(Earliest) Priority Date *(day/month/year)* 27 October 1998

Applicant
National University of Singapore (et al.)

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (See Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure

☐ because this figure better characterizes the invention

☐ None of the figures

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 99/00103

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: G06F 17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: AS ABOVE AND G06F 3/00, 19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent WPAT, USPTO, IBM
keywords: database, data, GUI, display, information, weave, ribbon.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5623418 (Rostoker et al.) 22 April 1997	1 to 24
A	US 5544352 (Egger) 6 August 1996	1 to 24
A	US 4672683 (Matsueda) 9 June 1987	1 to 24

☐ Further documents are listed in the continuation of Box C

☐ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
25 November 1999

Date of mailing of the international search report
-7 DEC 1999

Name and mailing address of the ISA/AU
AUSTRALIAN PATENT OFFICE
PO BOX 200
WODEN ACT 2606
AUSTRALIA
Facsimile No.: (02) 6285 3929

Authorized officer

P. CLAYTON-STAMM
Telephone No.: (02) 6283 2168

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference SS/CK/556/98	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. **PCT/SG 99/00103**	International filing date *(day/month/year)* 22 October 1999	(Earliest) Priority Date *(day/month/year)* 27 October 1998
Applicant National University of Singapore (et al.)		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (See Box II).

4. With regard to the **title,**

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

☒ the text is approved as submitted by the applicant

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure

☐ because this figure better characterizes the invention

☐ None of the figures

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 99/00103

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: G06F 17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: AS ABOVE AND G06F 3/00, 19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent WPAT, USPTO, IBM
keywords: database, data, GUI, display, information, weave, ribbon.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5623418 (Rostoker et al.) 22 April 1997	1 to 24
A	US 5544352 (Egger) 6 August 1996	1 to 24
A	US 4672683 (Matsueda) 9 June 1987	1 to 24

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Date of the actual completion of the international search	Date of mailing of the international search report
25 November 1999	-7 DEC 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **P. CLAYTON-STAMM** Telephone No.: (02) 6283 2168

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NOTIFICATION OF THE RECORDING OF A CHANGE

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SACHITHANANTHAN, Suresan
Tan, Rajah & Cheah
Straits Trading Building
9 Battery Road #15-00
Singapore 049910
SINGAPOUR

Date of mailing (day/month/year)
27 March 2000 (27.03.00)

Applicant's or agent's file reference
SS/CK/556/98

IMPORTANT NOTIFICATION

International application No.
PCT/SG99/00103

International filing date (day/month/year)
22 October 1999 (22.10.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
NATIONAL UNIVERSITY OF SINGAPORE
10 Kent Ridge Crescent
Singapore
Singapore 119260
Singapore

State of Nationality: SG
State of Residence: SG
Telephone No.: 65-8742987
Facsimile No.: 65-7776990
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[X] the person [ ] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address
JOHNS HOPKINS SINGAPORE PTE LTD
Level 5, Clinical Research Centre
(MDII)
National University of Singapore
10 Medical Drive
Singapore 117597
Singapore

State of Nationality: SG
State of Residence: SG
Telephone No.: 65-8747603
Facsimile No.: 65-7735647
Teleprinter No.:

3. Further observations, if necessary:
The applicant appearing in Box 1 has assigned the above PCT International Application to the applicant appearing in Box 2.

4. A copy of this notification has been sent to:

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34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
R. Chrem
Telephone No.: (41-22) 338.83.38

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(71) Applicant *(for all designated States except US)*: JOHNS HOPKINS SINGAPORE PTE LTD [SG/SG]; Level 5, Clinical Research Centre (MDII), National University of Singapore, 10 Medical Drive, Singapore 117597 (SG).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: POSTON, David [GB/GB]; Hill Farm, The Street, Flixton, Suffolk NR35 1NZ (GB). POSTON, Timothy [GB/SG]; 14 Whitchurch Road, Singapore 138822 (SG). RAGHAVAN, Raghu [US/US]; 4203 Somerset Place, Baltimore, MD 21210 (US). RAPPEL, James, Kolenchery [IN/SG]; Block 812, 81 Jurong West Street #04-154, Singapore 640812 (SG).

(74) Agent: SACHITHANANTHAN, Suresan; Tan, Rajah & Cheah, Straits Trading Building, 9 Battery Road #15-00, Singapore 049910 (SG).

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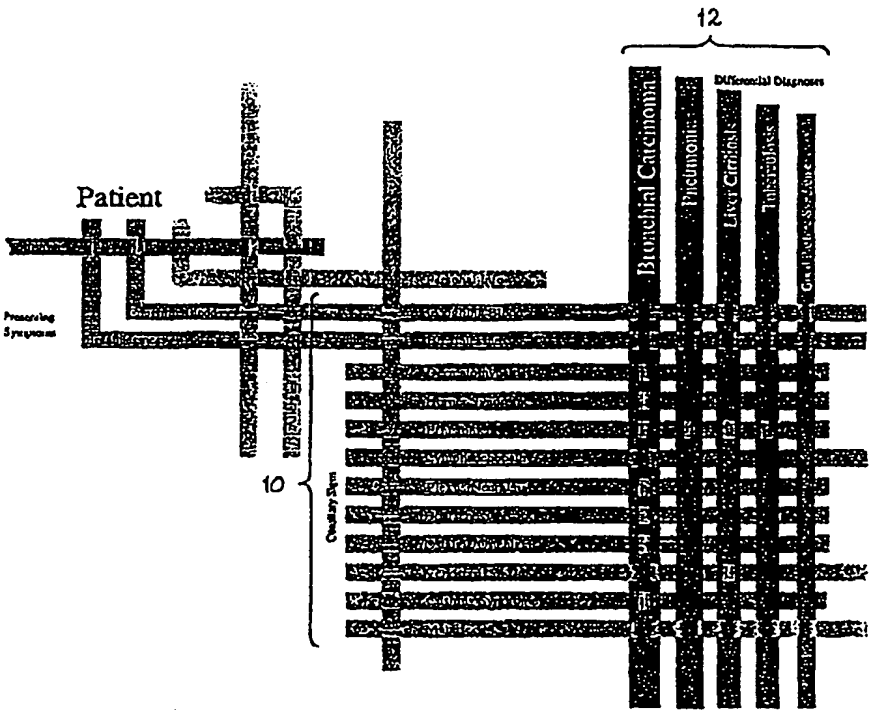
(54) Title: INFORMATICS SYSTEM WEAVES

(57) Abstract

The invention is a method of visually representing the relationships between data and actions, including a time dimension where this is required. It does this through the representation of items of data as "ribbons" which are "woven" in a pattern appropriate to the subject, and by using different visual arrangement for the intersections between these ribbons in order to convey different meanings. These arrangements include straight forward under–and–over intersections, but also use the metaphor of one or two longitudinal slits in one ribbon through which the other ribbon is threaded. The use of intersections with differing symbolic significance makes it possible to represent in two dimensional form a level of complexity which would otherwise require three dimension to be visualised. This form of weave diagram is particularly useful for data handling and data mining applications on computers and can be used as the basis for a graphical user interface.



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INFORMATICS SYSTEM WEAVES

FIELD OF THE INVENTION

This invention arises in the field of informatics, the correlation of multiple types of information and the graphic representation of relationships between types and pieces of information. The present invention relates to a method and system of visually representing the relationships between items or groups of data using "weaving" of "ribbons" as a metaphor and relates particularly, though not exclusively, to an application in the medical field for visually representing diagnosis, treatment planning, management and monitoring of a patient.

BACKGROUND TO THE INVENTION

Throughout the following specification the term "weave" is used to describe intersecting two-dimensional graphic lines referred to as "ribbons" used for visually representing items or groups of data. The terms "data" and "information" are used interchangeably and can mean single items or groups or classes of data.

Visualising the organisation of large quantities of information and complex interrelationships has always been problematic. Typically, this is done by means of a matrix table or by separating the information into a series of discrete groups each sufficiently small to illustrate with a diagram. However, even such diagrams are often an unsatisfactory means to explain complex sets of interrelationships, particularly where there are multiple connections between single elements of different groups or classes. A number of standard diagram systems are widely used but none of them satisfactorily overcome this problem.

Where a complex series of relationships between many elements is to be illustrated the separation of data is unsatisfactory. The use of a matrix permits only the identification of intersections between two pieces of data at a time but does not simultaneously illustrate the relationship between the various other

data. The problems are compounded where time is a significant factor requiring illustration.

It is possible to illustrate greater quantities of data by means of three-dimensional diagrams but these tend to lose clarity and are difficult to execute satisfactorily for use on a two-dimensional surface such as paper or a visual display screen.

SUMMARY OF THE INVENTION

The present invention was developed with a view to providing a method and system of visually representing the relationships between items or groups of data in a more readily understood manner.

According to one aspect of the present invention there is provided a method of visually representing in a computer generated graphic image the relationships between single items or groups of data, the method involving:

generating a first elongate ribbon in a form suitable for graphic display in a first visually distinct manner;

attaching a first item or group of data to said first ribbon;

generating a second elongate ribbon in a form suitable for graphic display in a second visually distinct manner;

attaching a second item or group of data to said second ribbon;

generating an intersection for a point at which said first and second ribbons overlap by weaving the two ribbons in a visually distinct form suitable for graphic display; and,

displaying said first and second ribbons on a display means together with said intersection;

wherein said intersection is used to provide a visual indication of a relationship between the first and second items or groups of data that can be readily ascertained by viewing the displayed graphic image.

Typically said first ribbon is one of a plurality of ribbons forming a first ribbon group, and said first item or group of data is one of a plurality of first items or groups of data attached to the respective first ribbons in said first ribbon group. Typically said second ribbon is one of a plurality of ribbons forming a second ribbon group, and said second item or group of data is one of a plurality of second items or groups of data attached to the respective second ribbons in said second ribbon group. Advantageously said intersection is one of a plurality of intersections which together with the ribbons form a weave of said first and second ribbon groups.

Preferably said first ribbons are displayed in a different colour from said second ribbons. Preferably said first ribbons overlap one or more of said second ribbons in a substantially perpendicular manner. Advantageously said plurality of ribbons within a particular ribbon group can be generated with varying degrees of thickness and height dimensions so as to convey additional information about items or groups of data represented in said particular ribbon group.

Typically said first ribbons are displayed on said display means in a substantially horizontal orientation and said second ribbons are displayed in a substantially vertical orientation.

Advantageously each intersection can be generated in one of a plurality of visually distinct forms so as to indicate a plurality of distinct relationships between said first and second items or groups of data. Preferably, in addition to a simple one over one under form, said intersection can take one or more of the following visually distinct forms: one ribbon passes through a single slit in the other ribbon (over-through-under); one ribbon passes through two adjacent slits in the other ribbon so that the passing ribbon is not visible between the two slits (over-through-under-through-over); one ribbon passes through two adjacent slits in the other ribbon so that the passing ribbon is only visible between the two slits (under-through-over-through-under). Preferably said slits are made

substantially perpendicular to the longitudinal direction of the passing ribbon whereby each of said intersection forms enables one ribbon to be visually dominant. On the other hand, said single slit can be made substantially diagonal to the longitudinal direction of both ribbons at the point of overlap so that neither ribbon will be visually dominant.

Preferably, said weave is one of a plurality of weaves, each weave representing a set of relationships between each first and second items or groups of data of each weave, said weaves forming a map of said set of relationships.

Preferably, selected ribbons pass from one weave to another within the same map, each ribbon passing from one weave to another representing the same item or group of data in each weave.

According to another aspect of the present invention there is provided a system for visually representing in a computer generated graphic image the relationships between single items or groups of data, the system comprising:

means for generating a first elongate ribbon in a form suitable for graphic display in a first visually distinct manner;

means for attaching a first item or group of data to said first ribbon;

means for generating a second elongate ribbon in a form suitable for graphic display in a second visually distinct manner;

means for attaching a second item or group of data to said second ribbon;

means for generating an intersection for a point at which said first and second ribbons overlap by weaving the two ribbons in a visually distinct form suitable for graphic display; and,

means for displaying said first and second ribbons together with said intersection as a graphic image on a display means;

wherein said intersection is used to provide a visual indication of a relationship between said first and second items or groups of data that can be more readily ascertained by viewing the displayed graphic image.

Typically said means for generating a first ribbon is capable of generating a plurality of said first ribbons so as to form a first ribbon group, and said means for attaching a first item or group of data is capable of attaching a plurality of first items or groups of data to said respective first ribbons in said first ribbon group. Typically said means for generating a second ribbon is capable of generating a plurality of said second ribbons so as to form a second ribbon group, and said means for attaching a second item or group of data is capable of attaching a plurality of second items or groups of data to said respective second ribbons in said second ribbon group.

Advantageously said means for generating an intersection is capable of generating a plurality of intersections which together with the ribbons form a weave of said first and second ribbon groups.

Preferably said system includes a means for querying a knowledge base for data to be represented by one of the ribbons. Preferably said system includes a means for a user to enter the relationship between the said first and second items or groups of data.

Preferably said system also includes a means for a user to input information to be represented by one of the ribbons. Preferably said system includes a means for querying a knowledge base for the relationship between the said first and second items or groups of data.

In order to facilitate a more comprehensive understanding of the nature of the invention a preferred embodiment of the method and system for visually representing the relationships between items or groups of data will now be

described in detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a computer generated "weave" pattern of first and second ribbon groups in accordance with a preferred embodiment of the invention;

Figure 2 illustrates several different forms that intersections of the ribbons can take and typical meanings ascribed thereto;

Figure 3 is a flow chart illustrating a preferred method of creating a weave map similar to that illustrated in Figure 1;

Figure 4 is a block diagram illustrating an ideal software architecture for a typical medical application which employs the DataWeaver method and system in accordance with the invention;

Figure 5 is a functional block diagram illustrating a typical clinical computer system that could employ the software architecture of Figure 4;

Figure 6 illustrates a single page Graphical User Interface (GUI) which embodies the DataWeaver method;

Figure 7 is an enlargement of the upper left of the single page GUI of Figure 6, showing the names of diseases and symptoms;

Figure 8 is an enlargement of the lower left of the single page GUI of Figure 6, showing features relating to diagnosis and patient information;

Figure 9 is an enlargement of the lower right of the single page GUI of Figure 6, showing a lower part of features relating to treatment and monitoring; and,

Figure 10 is an enlargement of the upper right of the single page GUI of Figure 6, showing an upper part of the features relating to treatment and monitoring.

The present invention provides an improved method of visualising relationships between sets and individual pieces of information in a computer generated image or map. It has particular advantages for the indication of significant intersections between data items or groups and is thus highly suitable for illustrating computer data handling and data-minding applications, for example, within the medical field for diagnosis and for treatment planning, management and monitoring. Throughout the following description a preferred embodiment of the invention will be described within the medical field, however it is to be understood that the method and system of the invention is not limited to this application and can be applied generally to multi-level information-based systems, such as monitoring of complex engineering plants, data flow in an algorithm or device, ecology, event planning, or geophysics. The computer generated image or map created in accordance with the invention may also be used as a basis for a Graphical User Interface (GUI).

The method involves visualising each item (or group) of data as a ribbon, typically colour coded to indicate the group or class of data which it represents. The direction of each ribbon can be adjusted in order to enable the appropriate intersections with other ribbons of data. The intersections between the various data ribbons use the analogy of weaving to generate a "weave" pattern of multi-coloured "ribbons" as illustrated in Figure 1. Hence, the method of visually representing in a computer generated image the relationships between items or groups of data will henceforth be referred to as the DataWeaver method for convenience.

Figure 1 illustrates a weave pattern or map which visually represents part of a patient record in a clinical system as developed using a preferred embodiment of the DataWeaver method in accordance with the invention. Generation of a full patient record will be described in more detail below with reference to

Figures 6 to 10. For the moment, it will suffice to note that the weave pattern comprises a first group of elongate ribbons 10 displayed in a first visually distinct manner, in this case in an easily identifiable colour, and displayed on a display screen in a substantially horizontal orientation. In this case, two of the ribbons in the first group 10 represent two presenting symptoms respectively ("coughing blood" and "breathlessness"), together with a plurality of corollary signs used to assist with diagnosis of the patient's illness.

A second group of elongate ribbons 12 are displayed in a substantially vertical orientation and are arranged to overlap with the first group of ribbons 10. In this illustrated example, the second group of ribbons 12 represent a variety of possible diagnoses of the patient's illness. In accordance with the DataWeaver method, a visually distinct intersection is generated for each point at which a ribbon from the first group 10 overlaps with a ribbon from the second group 12. Using the analogy of weaving, each intersection would normally give only the simple options of "A" over "B" or "B" over "A". This would merely give two meanings to each intersection, one of which may typically be "not relevant". However, the complexity of some weaves would mean that the priority of these two options, i.e., which one carries the meaning "not relevant" would quickly become confusing. The DataWeaver method therefore preferably extends the analogy of ribbon weaving by providing appropriately located longitudinal slits in one ribbon, through which the other ribbon passes. This provides an increased number of ways in which the intersection can be generated and thus provide a series of distinct meanings. Other icons may be used, including a question mark to tell the user that absent information could be useful, but the preferred implementation maintains the metaphor of physical ribbons.

Examples of the meanings which may be ascribed to different forms of intersection are illustrated in Figure 2 as follows:

Intersection 14	*Relevant:* Slit in centre of A,B passes through (over-through-under).
Intersection 16	*Not relevant:* simple one over, one under.

Intersection 18	*Present (e.g., symptom):* Two equally-spaced slits in A,B, passes through these so that the passing ribbon (B) is not visible between the two slits (over-through-under-through-over)
Intersection 20	*Not present (e.g., symptom):* Two equally-spaced slits in A,B passes through these so that the passing ribbon (B) is only visible between the two slits (under-through-over-through-under).
Intersection 22	*For investigation:* The two ribbons intersect diagonally, neither dominating.

With the exception of the last example, intersection 22, each of these forms of intersection makes one ribbon visually dominant at the point of overlap. For example, with intersection form 18 (*present*) the vertical ribbon is visually dominant as it is visible between the two slits, whereas with intersection from 20 the horizontal ribbon is visually dominant as it is visible between the two slits. Thus, if the weaving through the slits is organised consistently a visual "flow" can easily be discerned, giving a further information dimension. Where *present* and *not present* intersection indicators are being used, for example, in relation to medical symptoms, a clear passage down the middle of the dominant ribbon representing a possible diagnosis is immediately obvious, thus sending a clear message regarding the pattern of data relationships and increasing the probability of an accurate diagnosis. By contrast, the *not present* intersection indicator blocks the centre passage along the dominant ribbon, and hence a negative message is given by the interruption of the visual "flow".

The height and width of a particular data ribbon can also be used to represent magnitude, or as in the case of differential diagnosis, comparative probability. Thus, in Figure 1, the ribbons in the second ribbon group 12 have been generated with varying degrees of thickness and mapped in decreasing order of probability. Thus, based on the diagnosis so far, Bronchial Carcinoma would

appear to be the most likely illness of those considered, whereas Goodpasture's Syndrome is the least likely.

The software which embodies the DataWeaver method is built as a general class of re-useable graphical widgets (viz. the area, map, weave, ribbon, ribbon group, intersections, time-box). The entire map is assembled by combining these widgets and attaching "information" and "action" objects to them according to the application process and logic. The map gets it direction of flow from the application logic/processes. The flow chart illustrated in Figure 3 shows the way a map may be constructed using the widgets. In the embodiment of Figure 3, three distinct ribbon groups and their intersections are being generated. In this context, a "weave" is a place at which many ribbons belonging to two or more ribbon groups intersect. A "map" is a collection of such ribbons, ribbon groups, intersections and weaves. An "information object" contains information regarding the object to which it is attached and its behaviour when it is clicked on using the left and right mouse buttons. An "action object" contains a specification of the action that is to be performed such as bring up a dialogue box, add ribbons, etc., when the left or right mouse button is clicked.

In accordance with the DataWeaver method, the computer software creates a map object at step 50 and then obtains the data for ribbon groups 1, 2 and 3 at steps 100, 200 and 300. In the illustrated example, the map to be created is designed to enable the visualisation of relationships between data items or groups represented by ribbon groups 1 and 2, and the relationships between data represented by ribbon groups 1 and 3. These relationships may be pre-defined within the databases from which the information is obtained, or may be entered by the user. The steps required to obtain intersection details for the ribbon groups 1 and 2 and for the ribbon groups 1 and 3 are shown as 400 and 500 respectively in Figure 3.

Having obtained the data for ribbon group 1 at step 100, the DataWeaver software then creates the appropriate number of ribbon objects for ribbon group

1 at step 102, corresponding to each of the respective items or groups of data. Information objects for each of the ribbons in ribbon group 1 are then created at 104, and information objects are attached to each of the ribbons in ribbon group 1 at 106. A similar process is followed in relation to ribbon groups 2 and 3.

When all of the intersection details for the ribbon groups 1 and 2 have been obtained at 400, the intersection objects for ribbon groups 1 and 2 are created at 402 together with an indication of the intersection type. An information object for each intersection is created at 404 and the information objects are attached to the intersection objects at 406. A similar process is adopted once the intersection details for the ribbon groups 1 and 3 have been obtained at 500. Once the information objects have been attached to the ribbons in groups 1 and 2 and to the intersection objects, the DataWeaver software creates a weave object at 600, and attaches the group 1 ribbons to the weave horizontally at 602. The group 2 ribbons are attached to the weave vertically at 604 and the ribbon group 1 and 2 intersection objects are attached to the weave at 606. The completed weave of ribbon groups 1 and 2 is then attached to the map at 800 and its position relative to other weaves on the map indicated. A similar process is adopted to create a weave object at 700, once the information objects have been attached to the ribbons in ribbon groups 1 and 3 and to the intersection objects. In this particular weave map, the group 1 ribbons always appear horizontally, whereas group 2 and group 3 ribbons appear vertically in the completed map. The weaves are arranged to determine their absolute position on the map at 802 and the map is then ready for display on a display screen at 804.

In addition to serving as a static graphic means of describing a topography of relationships and particular intersections, the DataWeaver method also lends itself to use as a graphic user interface (GUI) for computer programs dealing with information. The nature of the graphic image coincides with the manner in which program architectures are constructed, thus assisting in their preparation and increasing the ease of integration of superstructure and

substructure. The particular program architecture employed will depend to some extend on the specific application in which the DataWeaver method is embodied.

In order to further illustrate the nature of the invention a preferred embodiment of the DataWeaver method in the medical field will now be described with reference to Figures 4 to 6 in which a process by which the clinical data and encounters of a patient with the professional health care system are managed. In this embodiment, the DataWeaver software is embodied in a graphical user interface which is used in conjunction with other known software in clinical knowledge databases, patient records, etc. The DataWeaver method is not embodied in the software that underlies the actual graphical user interface (GUI) construction, which follows standard professional software practice. Figure 5 illustrates how a typical client/server clinical system which employs DataWeaver as a front end at the GUI may be set up. The DataWeaver front end communicates with the local clinical objects or the remote clinical objects to store and retrieve information in the databases 34 via servers 32.

Figure 4 illustrates an ideal software architecture for a clinical system employing DataWeaver which typically consists of five layers with client-server relationship between layers. A layered approach was chosen to build the system in order to make construction of the weave map modular and de-coupled from the underlying clinical system. The first layer at the front end is the GUI 40 which embodies the DataWeaver method. The second layer is the GUI/domain control layer 42 which assembles the map, communicates with the supporting clinical domain control layer 44 and provides the map with data and control logic. This second layer 42 defines the semantics and look and feel of the map (e.g., what does an intersection mean, what icons are used, definition of areas in map, etc.). The domain and services layer 44 consists of various domain objects and services implemented as components that can be distributed across several machines (e.g., patient records, treatment planning engine, log keeping and access control, etc.). The persistence management layer 46 takes care of storage and retrieval

of information in a platform and vendor independent way. The final layer 48 consists of the back end databases. The above-described layered approach decouples the DataWeaver method from the underlying clinical system and ensures the reuseability of the DataWeaver widgets in other applications within the medical field as well as in various other complex business, planning, engineering or scientific environments outside of the medical field.

The various events that take place when a patient visits a hospital for medical help constitute a clinical encounter. The patient is taken through a series of processes and is treated and monitored for various conditions that he/she may have. Fundamentally there is a work flow (a series of processes) and the data involved in this exercise. The most common steps are:

(a) register the patient
(b) interview the patient or responsible party
(c) acquire data on various signs and symptoms
(d) do a diagnosis based on what is acquired
(e) treat the patient based on the diagnosis/condition
(f) monitor various conditions/parameters

Figures 6 to 10 illustrates how the GUI employs the described embodiment of the DataWeaver method to present this series of processes and the associated data and relationships on a single page map for display on a video display unit (VDU). A hard copy of the display can also be printed in full colour on paper if required. The map is constructed dynamically by interacting with the user and the clinical objects. The overall topology and direction of process flow, however, is decided early in the program. The map shown in Figure 6 is a fully-grown map which grew in order from A to E as described below. The map consists of areas (portions boxed in by dotted lines, which need not be part of the active display) and weaves. An area comprises weaves related to the same process. A weave is a collection of two groups of ribbons, their intersections, and associated "information" and "action" objects. Information

objects display information and action objects perform a predefined action, (for example, collect data, validate, generate more weaves dynamically, etc.), on activation by clicking the intersections or the ribbons. The ribbons themselves are grouped based on their class, (for example, in the symptom group each ribbon in the group represents a symptom). Ribbon groups or individual ribbons may be involved in more than one weave.

The data which the ribbons represent may refer to a specific entity to be managed such as a patient, a ward, an X-ray facility, etc., or be drawn from a general knowledge base such as a knowledge base describing the relation between a symptom and a disease, the time and resources required for a particular X-ray examination, etc. These are referred to as the subject and the knowledge base respectively. Information about the subject may be drawn from the subject's file (for example, by electronic transfer of a patient's pre-existing records in another system) or entered by user interaction with the system. The clinical processes, the data involved and how they are presented in the DataWeaver map will now be described with reference to Figures 6 to 10.

The full weave map illustrated in Figure 6 is the end result of the patient-physician encounter, which commences with entry of the patient into the clinic (900) and registration in the administration section (910, 920). An administrative user registers the patient by recording within the system the demographic registration information (for Epidemiological purposes) for a new patient, which are stored for later use and documentation of that specific patient in the clinic. The administrative user interviews the patient/responsible party and obtains details of the presenting symptoms along with other condition facts, such as known allergies, drug sensitivity, current medication, pregnancy, etc. (910, 930, 940). Ribbons representing the presenting symptoms are generated in the weave map and the presenting symptoms are attached to the ribbons from the list which is searched by the user using key words. A preliminary disease/probability list is then created.

The patient/physician encounter then moves to the second phase involving initial diagnosis of the patient's complaint which is represented in area 1000 of the weave map. Based on further discussion with the patient a clinical user acquires and evaluates all the personal information, symptoms, signs, images (scans), genetic and environmental factors which are interactively stored (1010, 1020, 1030, 1040). The supporting knowledge base aids in prompting for related signs and symptoms. Allowance is made for hierarchical groupings of symptoms, if that is useful or needed. For example, both the height and thickness of disease ribbons (1040) indicate the relative probability of the disease. A diagnosis suggested by the system may be overridden by the clinician. The weaves 1030 and 1130 consist of intersections that show a particular sign or symptom is relevant to the disease. From the knowledge base, all symptom groups where the presented main symptoms are the leading symptoms for some specific diseases are chosen. The symptom group is classified by disease or disease group where system cross-relationships should be considered. Any disease may be clicked to view its corollary signs and symptoms and other relevant factors. The disease ribbon can be right-clicked to make it as the diagnosis. Question marks will appear at the points of overlap of the ribbons in a particular weave (not shown), where the relevant symptoms associated with each disease group have not yet been checked. The weave map, acting as it does in this case as a GUI for the knowledge base, acts as a prompt to aid the physician in asking the appropriate questions to find symptoms which may be indicated according to the disease assumptions. The visualisation of cross relationships between the observed symptoms, possible diseases and corollary symptoms are illustrated by the weave in area 1000.

More considerations are introduced to ascertain the diagnosis, including the patient's personal record (social and environmental factors and genetic predisposition, treatment history, drug side affects and other physical examination data). A clear pathway down a diagnostics column at the diagnostic/symptoms intersections indicates the symptoms are present. (If the

symptom is not needed for the diagnosis, the weave goes under the diagnosis ribbon indicating that it is not relevant).

Area 1200 of the weave map represents the process of consultation of research literature, past cases and other peers (1220). Various relevant literature and past cases are retrieved from the databases. The patient is also educated regarding the disease (1230) and relevant information to be handed out to the patient is retrieved from the database.

Once a diagnosis has been made (1360), the disease ribbon can be clicked to retrieve a list of treatment schemes available for that disease from the database. Each treatment scheme can be analysed dynamically against the patient conditions such as allergies, pregnancy, cost or patient preferences to choose the optimum strategy (1210, 1320, 1330 and 1340). Patient education on treatment and rehabilitation continues (ribbon 1230 extended to area 1354). Once a treatment plan is selected (1330), the individual items can be modified for dosage and administration mechanisms, etc. All the changes will be transmitted back to the patient records. Administration of treatment (therapies represented by three ribbons 1310) and ribbons representing a drugs and therapies daily plan are generated (1410, 1420 and 1430 in the monitoring area 1400). If a case is classified as of research interest, parameters and conditions to be monitored are captured for clinical research.

Weaves can be programmed to interact in different ways. Each weave is built interactively from a few ribbons and intersections to the complete set required. With any ribbon group, right clicking any ribbon opens a dialogue box that can add new ribbons by a tree-structured, keyword searchable list of possible additions. Right-clicking an intersection opens a dialogue box by which the user may alter those of that intersection's properties for which a user's profile specifies permission, whereas left clicking allows an authorised user to read the information represented by that intersection.

An example of this type is weave 1030, a weave of ribbons from the disease and symptoms group. Initially, only a placeholder ribbon for the symptoms is present, which disappears as soon as at least one specific symptom is specified. Right clicking on this brings up the tree-structured dialogue box which is searchable by keywords, diseases and so on, to add more symptoms. Selected symptom or symptom sets are added to the weave, as ribbons in the direction of the placeholder ribbon. When the displayed set of symptoms may be sufficient, the user brings in the disease ribbons by right clicking any symptom ribbon and choosing Pre-diagnose. The DataWeaver queries the diagnostic engine it is connected to (this engine may be any suitable software) which returns a list of probable diseases or disease clusters, with the relative probability of each. The user selects those of interest, or lets the system choose a default subset, starting with the most probable. These diseases or clusters are added to the weave as disease group ribbons. The type of intersection of a particular symptom ribbon and a disease ribbon indicates whether that symptom and disease are relevant to each other. The user can now click at an intersection that shows relevance to change the form of the intersection icon to a 'present' form of intersection that indicates the symptom is present in the patient. Repeating the pre-diagnosis can then lead to a more accurate result.

The display visualises more information than the relevance or presence shown by the intersections. The relative probability of the diseases can also be shown visually by change of width or ordering of the disease ribbons and other criteria may be input by the user or system manager.

The weave in 1130 of Figure 8 shows another interaction mechanism where the horizontal ribbons belong to the 'signs' group and the vertical ribbons belong to the 'disease' group. The relationship between the diseases/conditions and the signs is represented here. Left clicking a particular disease ribbon brings up on the left the relevant signs to look for. The weave shows the relationship between signs and diseases/conditions as "relevance" intersections

The weave logic can support many other types of interaction scheme for the weave, in either 'build-up' or 'post-build analysis' strategy.

The weave map allows the creation of specialised zones in which synchronised information of a specific nature is displayed for direct comparison, in this case, the time behaviour of indicators which is very important to the health-care givers especially in the period of treatment. It helps physician and nurses to monitor the patient's responses during the treatment process, and modify treatment accordingly. The GUI "explodes" a box in area 1400 (monitoring), where the primary dynamic indicators are displayed in the form the physician is accustomed to, typically as graphs of indicators against time (1440, 1450, 1470, 1480, 1490 and 1495). Correlations between the dynamical behaviour of different indicators may be viewed in the familiar form of pie-charts. The various parameters and conditions of the patient are monitored over time and any necessary modification to the treatment plan is effected. The generated patient record elements are stored. The time box (1400) works as a graphical and interactive progress chart. It can be clicked to get information about it or to scale it differently. As in the case of other ribbon groups, right clicking can add additional ribbons. The time box zone can be concealed to restore the longer-term view and the patient can continue to be monitored for side affects, their implementations for further treatment, etc.

A value of the DataWeaver approach is the ready integration of multiple streams of data for research and discovery purposes. For example, a physician can use this in a novel form of drug discovery where diseases that are related by symptoms, even though underlying causes are different, may lend themselves to improved treatment when such similarities are recognised in the weave map. New diseases can be recognised, initially as clusters of co-occurring symptoms (like the discovery of Acquired Immune Deficiency Syndrome), by using weaves to display the statistical strength of clusters. The research box (1500) is intersected by various forms of knowledge, and the weave diagram now shows a diagonal interlacing to show that a different level of knowledge integration is

being pursued. If a case is classified as being of research potential, parameters and conditions are added in and captured for clinical research (1510 and 1515). The research information may be retrieved from the database, or stored in it. The correlation of research information from several discrete Weaves is one example of the forming of a map.

From the above description of a preferred embodiment of the DataWeaver method and its implementation in a front end GUI in the clinical context, it will be evident that the visual representation of data by "ribbons" whose intersections carry differing significance denoted by the manner in which the intersections are arranged, greatly enhances the ability of the user to ascertain interrelationships between various items and groups of data. The significance of a group of intersections is clearly seen at a glance because the arrangements create a visual analogy of clear flow or blockage along the longitudinal axis of a particular ribbon or ribbon group. A variation of parameters over time (or other measure) is illustrated by the passage of the relevant ribbons through a synchronous "time box", allowing clear comparison at a glance. In cases where the weave map is becoming crowded within the available display area, selected sections of the diagram may be minimised, particularly within a dynamic context such as a computer VDU. The use of colour to define data groups or classes and variation of ribbon-width to indicate the magnitude (e.g., of probability) of the data represented by the ribbon further enhance the user-friendly nature of the DataWeaver methodology. Further advantages include the use of intersections as points of data extraction and contribution by means of left or right clicks of the computer mouse. The weave map allows a general analogy of direction to represent the flow of a process without the restriction of strict sequencing.

In addition user profiles may be provided which control the behaviour and appearance of the GUI according to the role and preferences of the user. Each category of user (admissions clerk, nurse, doctor, medical system administrator, etc) receives a default profile on initial registration with the system, which is customisable according to category. For example, any user may adjust the

default colours or zoom-lens size to optimise visual comfort and effectiveness for that user; an admission clerk's display may be limited to an interactive weave guiding the acquisition of admission data, and not extend to a weave assisting in treatment selection; a doctor may modify the symptom/disease relations in a personal copy of the knowledge base effecting the display generated for that doctor; a medical system administrator may modify the knowledge base or image generation rules affecting all users. (The administrator might choose or be directed to bring a particular disease to the clinician's attention even where the evidence acquired so far makes its presence possible but unlikely, on grounds of public policy).

While the medical embodiment described above is 'patient-oriented', with the display showing actual or possible symptoms for one patient (or, in research, for a group of patients), treatments considered or used for that patient, and so on, an administrator concerned with available beds, test scheduling, isolation requirements, etc, needs a 'resource-oriented' display. This may be constructed in an analogous fashion, using a knowledge base of resources and resource-requirement relationships, together with data from current patient records.

Now that a preferred embodiment of the DataWeaver method and system have been described in detail, it will be apparent to persons skilled in the computer systems arts that numerous variations and modifications may be made to the method, in addition to those already described, without departing from the basic inventive concepts. For example, the form in which intersections between overlapping ribbons are represented in the weave map may vary considerably from that described depending upon the particular application context. Also, in the above mentioned example, the method of entry of information by a user is with a mouse. It is envisaged that voice recognition could be used instead of or in addition to the use of a mouse. All such variations and modifications are to be considered within the scope of the present invention, the nature of which is to be determined from the foregoing description and the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of visually representing in a computer generated graphic image the relationships between single items or groups of data, the method involving:

generating a first elongate ribbon in a form suitable for graphic display in a first visually distinct manner;

attaching a first item or group of data to said first ribbon;

generating a second elongate ribbon in a form suitable for graphic display in a second visually distinct manner;

attaching a second item or group of data to said second ribbon;

generating an intersection for a point at which said first and second ribbons overlap by weaving the two ribbons in a visually distinct form suitable for graphic display; and,

displaying said first and second ribbons on a display means together with said intersection;

wherein said intersection is used to provide a visual indication of a relationship between the first and second items or groups of data that can be readily ascertained by viewing the displayed graphic image.

2. A method of visually representing data as defined in claim 1, wherein said first ribbon is one of a plurality of ribbons forming a first ribbon group, and said first item or group of data is one of a plurality of first items or groups of data attached to the respective first ribbons in said first ribbon group.

3. A method of visually representing data as defined in claim 2, wherein second ribbon is one of a plurality of ribbons forming a second ribbon group, and said second item or group of data is one of a plurality of second items or groups of data attached to the respective second ribbons in said second ribbon group.

4. A method of visually representing data as defined in claim 3, wherein said intersection is one of a plurality of intersections which together with the ribbons form a weave of said first and second ribbon groups.

5. A method of visually representing data as defined in claim 4, wherein said first ribbons are displayed in a different colour from said second ribbons.

6. A method of visually representing data as defined in claim 5, wherein said first ribbons overlap one or more of said second ribbons in a substantially perpendicular manner.

7. A method of visually representing data as defined in claim 6, wherein said plurality of ribbons within a particular ribbon group can be generated with varying degrees of thickness and height dimensions so as to convey additional information about items or groups of data represented in said particular ribbon group.

8. A method of visually representing data as defined in claim 7, wherein said first ribbons are displayed on said display means in a substantially horizontal orientation and said second ribbons are displayed in a substantially vertical orientation.

9. A method of visually representing data as defined in claim 1, wherein each intersection can be generated in one of a plurality of visually distinct forms so as to indicate a plurality of distinct relationships between said first and second items or groups of data.

10. A method of visually representing data as defined in claim 9, wherein, in addition to a simple one over one under form, said intersection can take one or more of the following visually distinct forms: one ribbon passes through a single slit in the other ribbon (over-through-under); one ribbon passes

through two adjacent slits in the other ribbon so that the passing ribbon is not visible between the two slits (over-through-under-through-over); one ribbon passes through two adjacent slits in the other ribbon so that the passing ribbon is only visible between the two slits (under-through-over-through-under).

11. A method of visually representing data as defined in claim 10, wherein said slits are made substantially perpendicular to the longitudinal direction of the passing ribbon whereby each of said intersection forms enables one ribbon to be visually dominant.

12. A method of visually representing data as defined in claim 10, wherein, said single slit can be made substantially diagonal to the longitudinal direction of both ribbons at the point of overlap so that neither ribbon will be visually dominant.

13. A method of visually representing data as defined in claim 4, wherein said weave is one of a plurality of weaves, each weave representing a set of relationships between each first and second items or groups of data of each weave, said weaves forming a map of said sets of relationships.

14. A method of visually representing data, as defined in claim 13, wherein selected ribbons pass from one weave to another, within the same map, each ribbon passing from one weave to another representing the same item or group of data in each weave.

15. A system for visually representing in a computer generated graphic image the relationships between single items or groups of data, the system comprising:

means for generating a first elongate ribbon in a form suitable for graphic display in a first visually distinct manner;

means for attaching a first item or group of data to said first ribbon;

means for generating a second elongate ribbon in a form suitable for graphic display is a second visually distinct manner;

means for attaching a second item or group of data to said second ribbon;

means for generating an intersection for a point at which said first and second ribbons overlap by weaving the two ribbons in a visually distinct form suitable for graphic display;

means for displaying said first and second ribbons together with said intersection as a graphic image on a display means;

wherein said intersection is used to provide a visual indication of a relationship between said first and second items or groups of data that can be more readily ascertained by viewing the displayed graphic image.

16. A system for visually representing data as defined in claim 15, wherein said means for generating a first ribbon is capable of generating a plurality of said first ribbons so as to form a first ribbon group, and said means for attaching a first item or group data is capable of attaching a plurality of first items or groups of data to said respective first ribbons and in said ribbon group.

17. A system for visually representing data as defined in claim 16, wherein said means for generating a second ribbon is capable of generating a plurality of said second ribbons so as to form a second ribbon group, and said means for attaching a second item or group of data is capable of attaching a plurality of second items or groups of data to said respective second ribbons in said second ribbon group.

18. A system for visually representing data as defined in claim 17, wherein said means for generating an intersection is capable of a plurality of intersections which together with the ribbons form a weave of said first and second ribbon groups.

19. A system of visually representing data as defined in claim 18, which includes a means for querying a knowledge base for data to be represented by one of the ribbons.

20. A system of visually representing data as defined in claim 19, which includes a means for querying a knowledge base for data to be represented by another ribbon that is to be added to the weave.

21. A system of visually representing data as defined in claim 20, which includes a means for a user to input information to be represented by one of the ribbons.

22. A system of visually representing data as defined in claim 21, which includes a means for a user to input information to be represented by another ribbon that is to be added to the weave.

23. A system of visually representing data as defined in claim 20, which includes a means for a user to enter the relationship between the said first and second items or groups of data.

24. A system of visually representing data, as defined in claim 21 which includes a means for querying a knowledge base for the relationship between the said first and second items or groups of data.

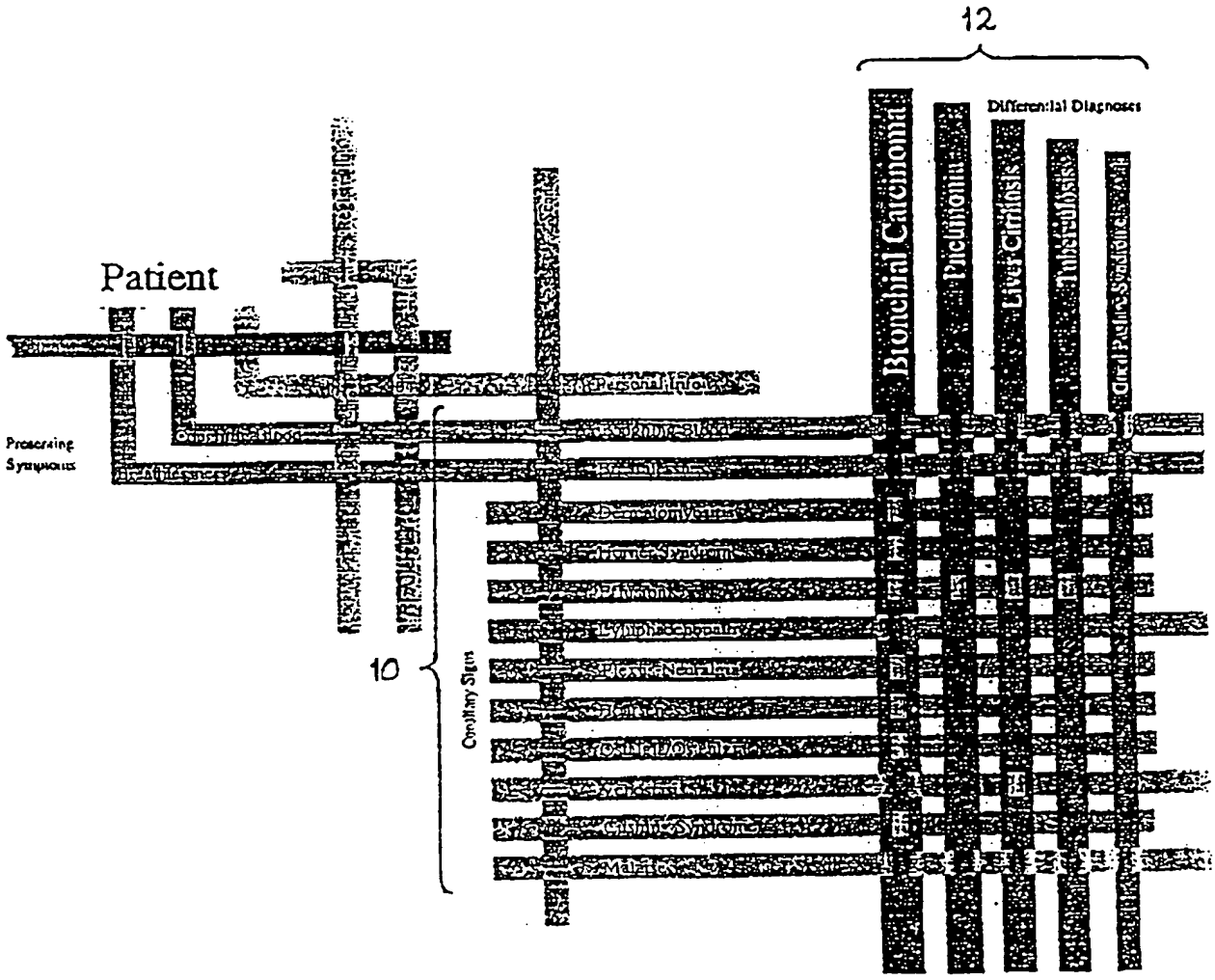
12
Differential Diagnoses
Bronchial Carcinoma
Pneumonia
Liver Cirrhosis
Tuberculosis
Viral Hepatitis Syndrome
Patient
Presenting Symptoms
Personal Info
10
Cardiac Signs

FIG. 1.

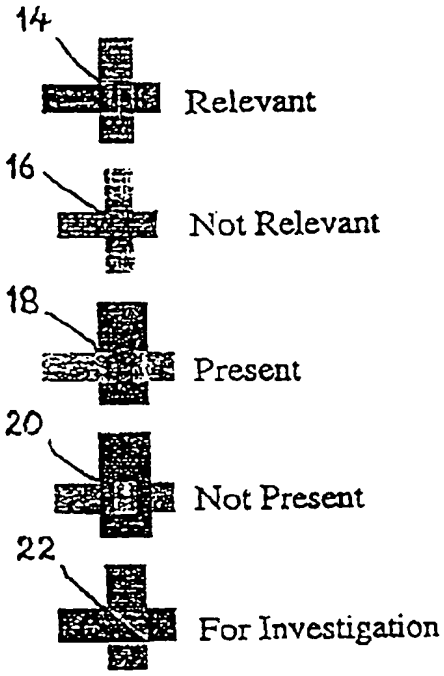
14
Relevant
16
Not Relevant
18
Present
20
Not Present
22
For Investigation

FIG. 2.

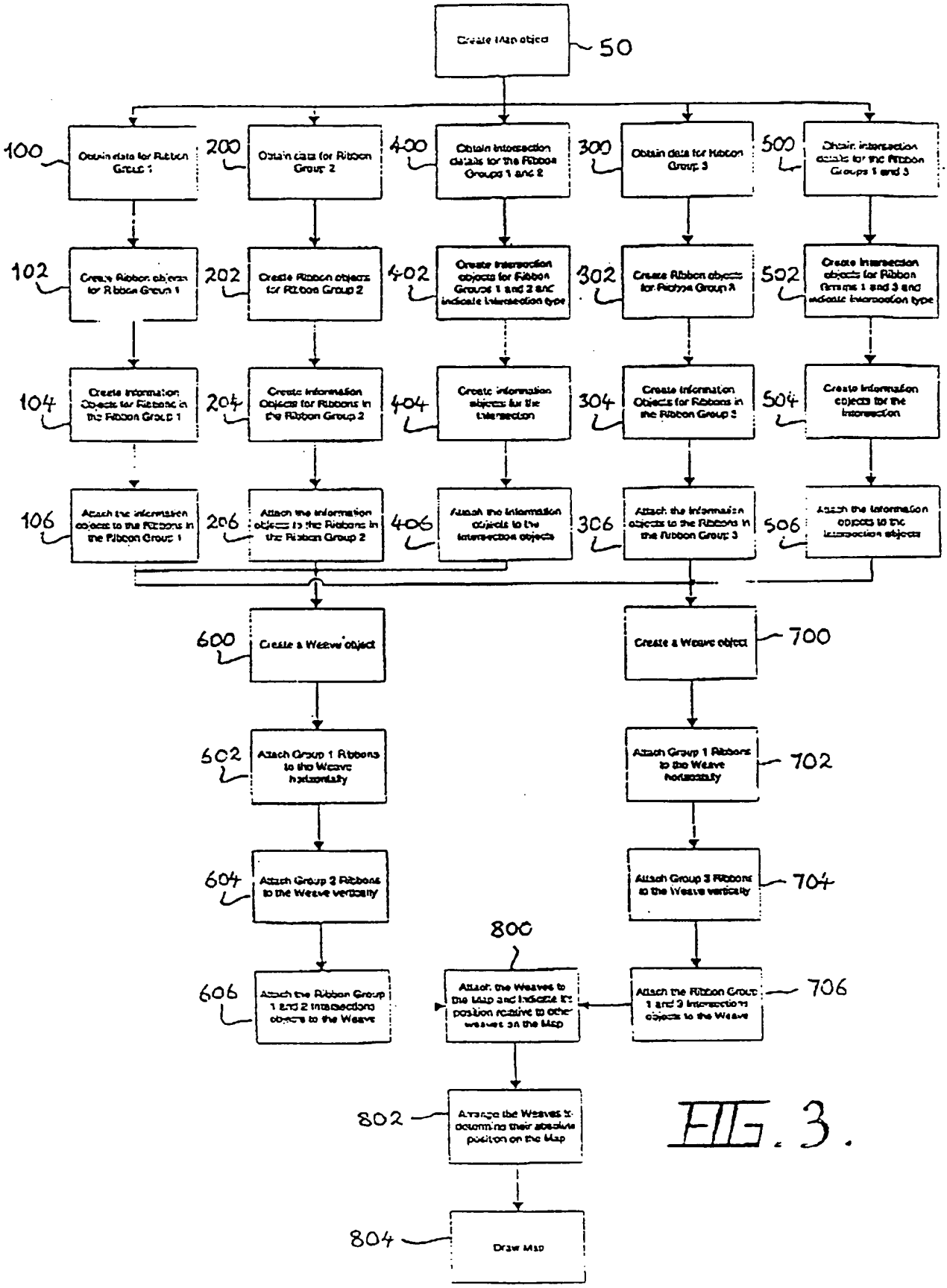
Create Map object
50
100
Obtain data for Ribbon Group 1
200
Obtain data for Ribbon Group 2
400
Obtain intersection details for the Ribbon Groups 1 and 2
300
Obtain data for Ribbon Group 3
500
Obtain intersection details for the Ribbon Groups 1 and 3
102
Create Ribbon objects for Ribbon Group 1
202
Create Ribbon objects for Ribbon Group 2
402
Create intersection objects for Ribbon Groups 1 and 2 and indicate intersection type
302
Create Ribbon objects for Ribbon Group 3
502
Create intersection objects for Ribbon Groups 1 and 3 and indicate intersection type
104
Create information Objects for Ribbons in the Ribbon Group 1
204
Create information Objects for Ribbons in the Ribbon Group 2
404
Create information objects for the intersection
304
Create information Objects for Ribbons in the Ribbon Group 3
504
Create information objects for the intersection
106
Attach the information objects to the Ribbons in the Ribbon Group 1
206
Attach the information objects to the Ribbons in the Ribbon Group 2
406
Attach the information objects to the intersection objects
306
Attach the information objects to the Ribbons in the Ribbon Group 3
506
Attach the information objects to the intersection objects
600
Create a Weave object
700
Create a Weave object
602
Attach Group 1 Ribbons to the Weave horizontally
702
Attach Group 1 Ribbons to the Weave horizontally
604
Attach Group 2 Ribbons to the Weave vertically
704
Attach Group 3 Ribbons to the Weave vertically
800
606
Attach the Ribbon Group 1 and 2 intersection objects to the Weave
Attach the Weaves to the Map and indicate its position relative to other weaves on the Map
706
Attach the Ribbon Group 1 and 3 intersection objects to the Weave
802
Arrange the Weaves to determine their absolute position on the Map
804
Draw Map

FIG. 3.

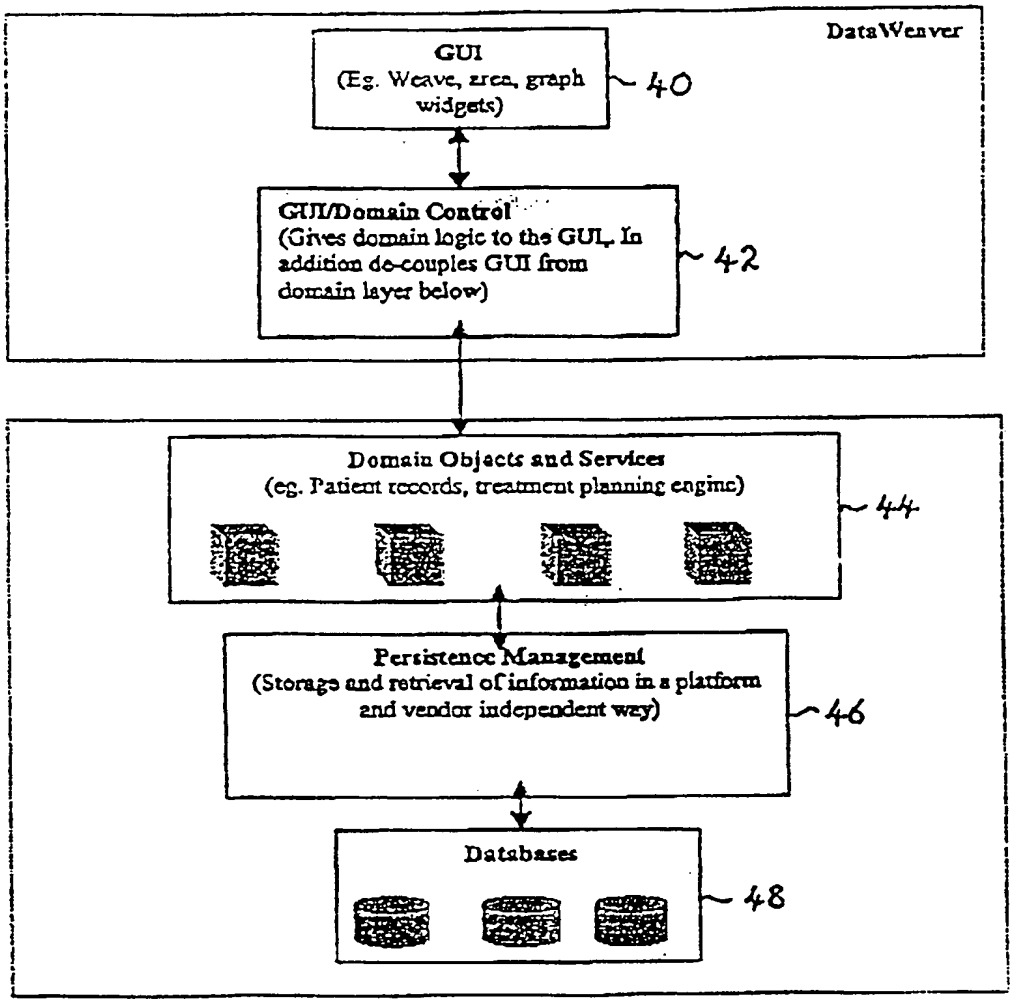
DataWeaver
GUI
(Eg. Weave, area, graph widgets)
40
GUI/Domain Control
(Gives domain logic to the GUI. In addition de-couples GUI from domain layer below)
42
Domain Objects and Services
(eg. Patient records, treatment planning engine)
44
Persistence Management
(Storage and retrieval of information in a platform and vendor independent way)
46
Databases
48

FIG. 4.

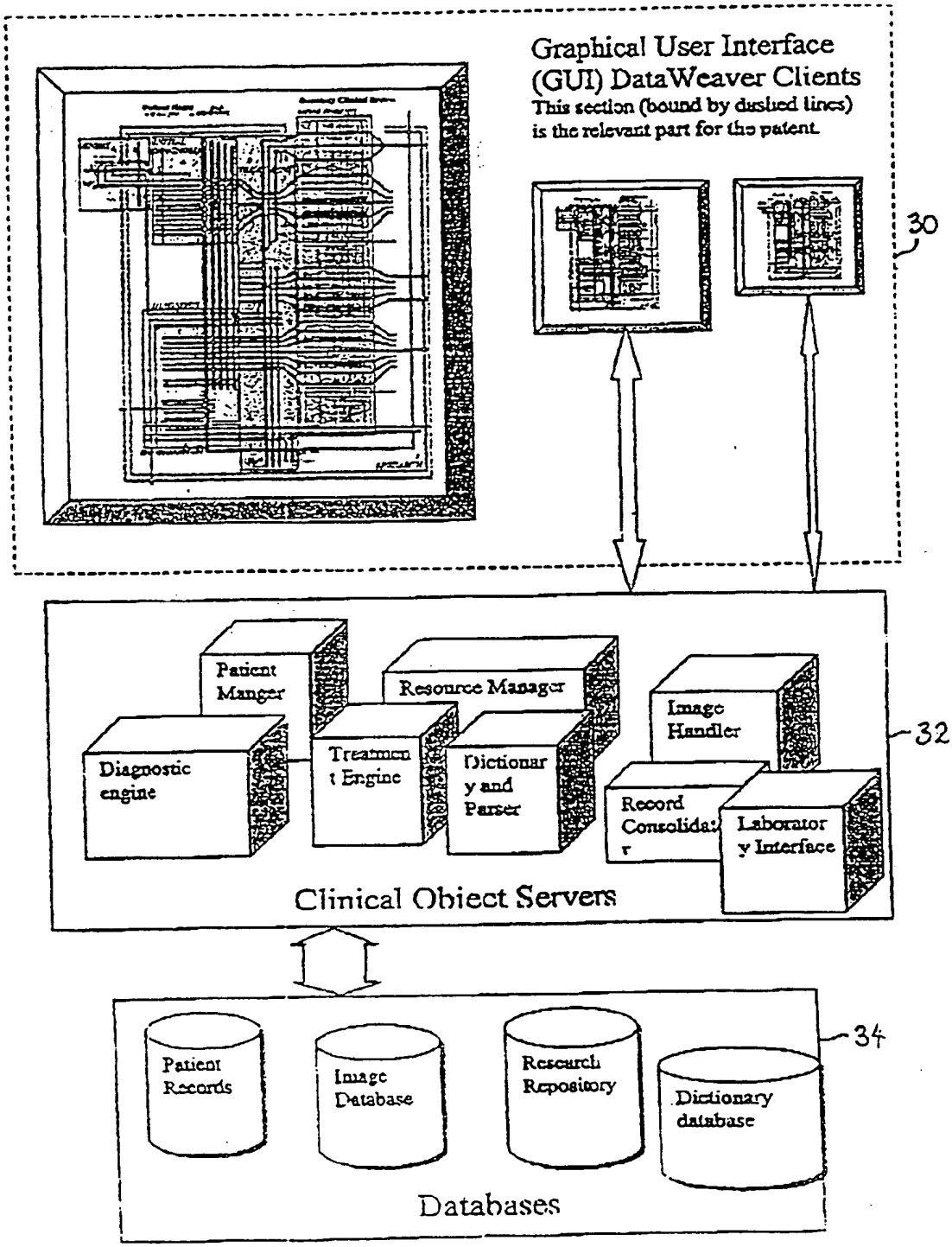
Graphical User Interface
(GUI) DataWeaver Clients
This section (bound by dashed lines)
is the relevant part for the patent
30
Patient Manger
Resource Manager
Image Handler
Diagnostic engine
Treatmen t Engine
Dictionar y and Parser
Record Consolida r
Laborator y Interface
32
Clinical Object Servers
Patient Records
Image Database
Research Repository
Dictionary database
34
Databases

FIG. 5.

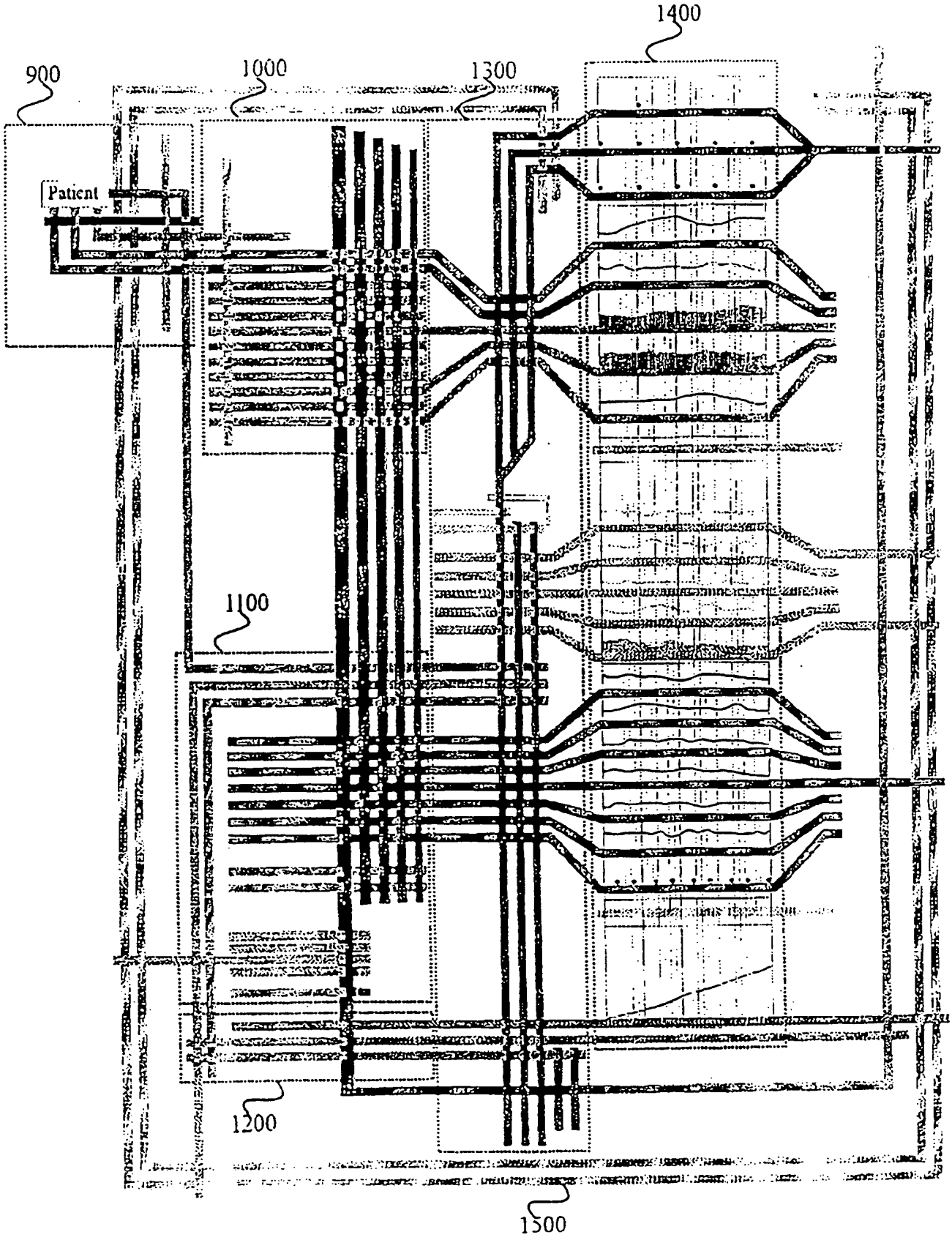

Fig. 6

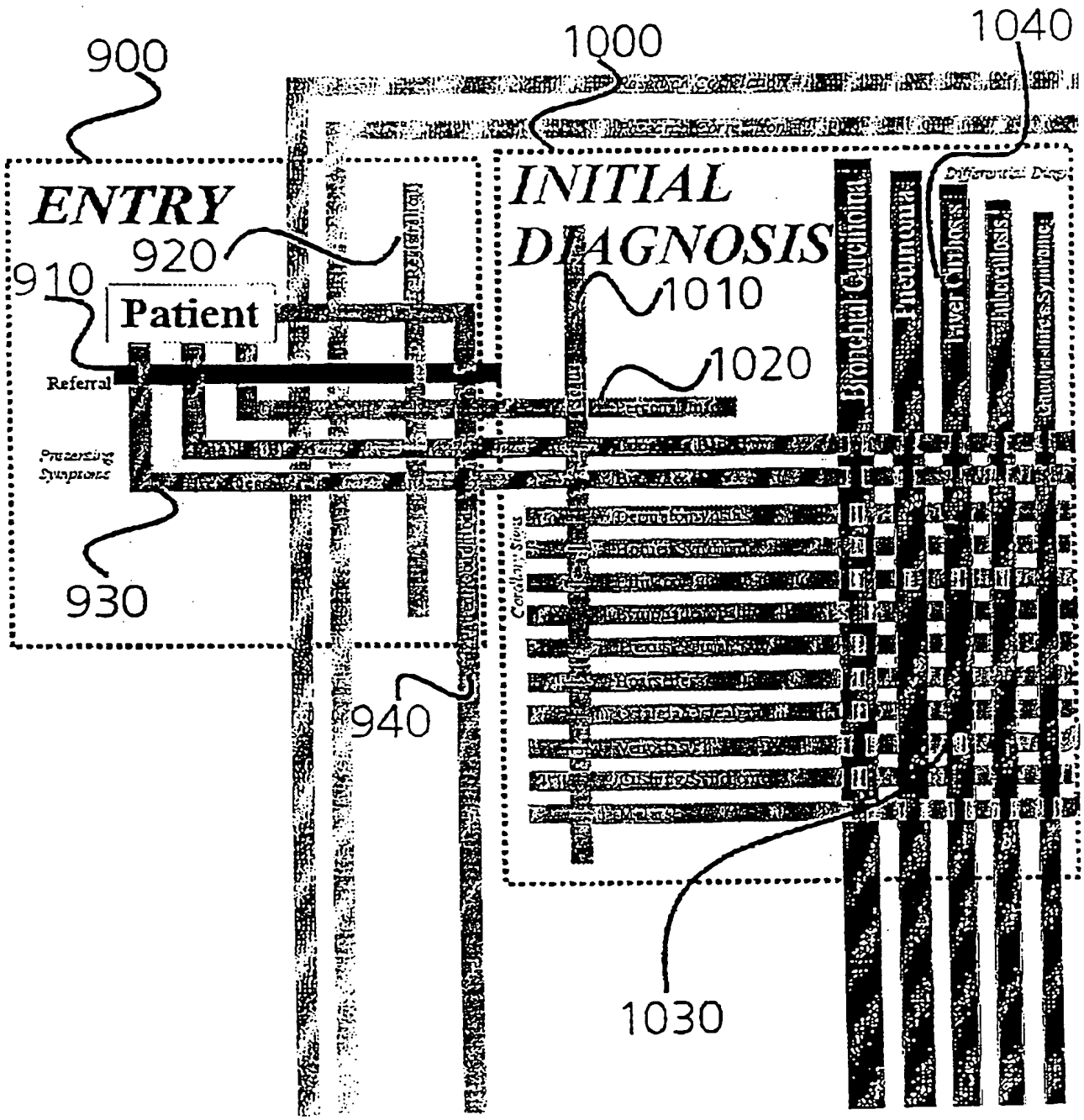
900
1000
1040
ENTRY
INITIAL
DIAGNOSIS
920
910
Patient
1010
1020
Referral
930
940
1030
Bronchial Carcinoma
Pneumonia
Liver Cirrhosis
Tuberculosis

Fig. 7

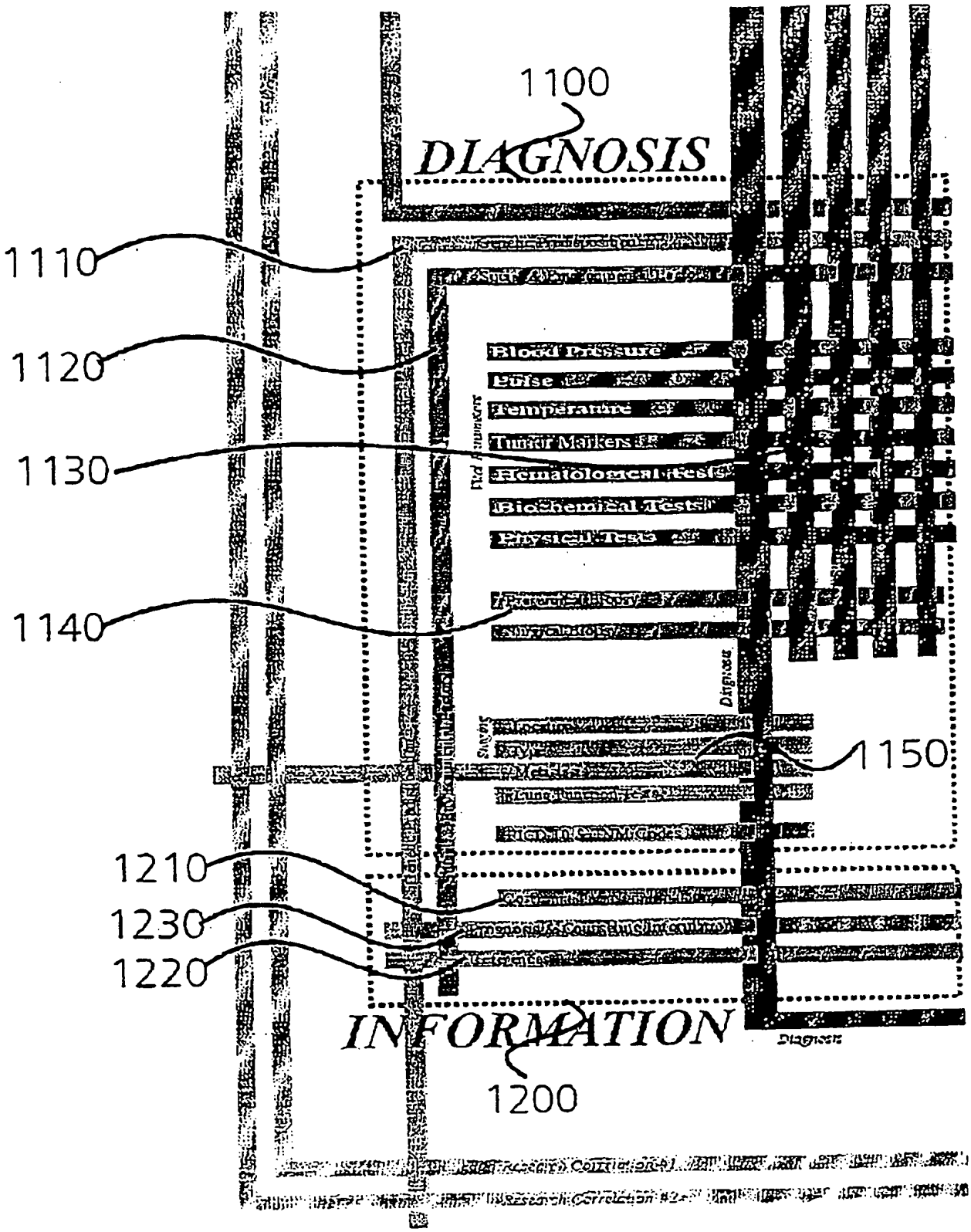
1100
DIAGNOSIS
1110
1120
1130
1140
1150
1210
1230
1220
INFORMATION
1200
Blood Pressure
Pulse
Temperature
Tumor Markers
Hematological Tests
Biochemical Tests
Physical Tests

Fig. 8

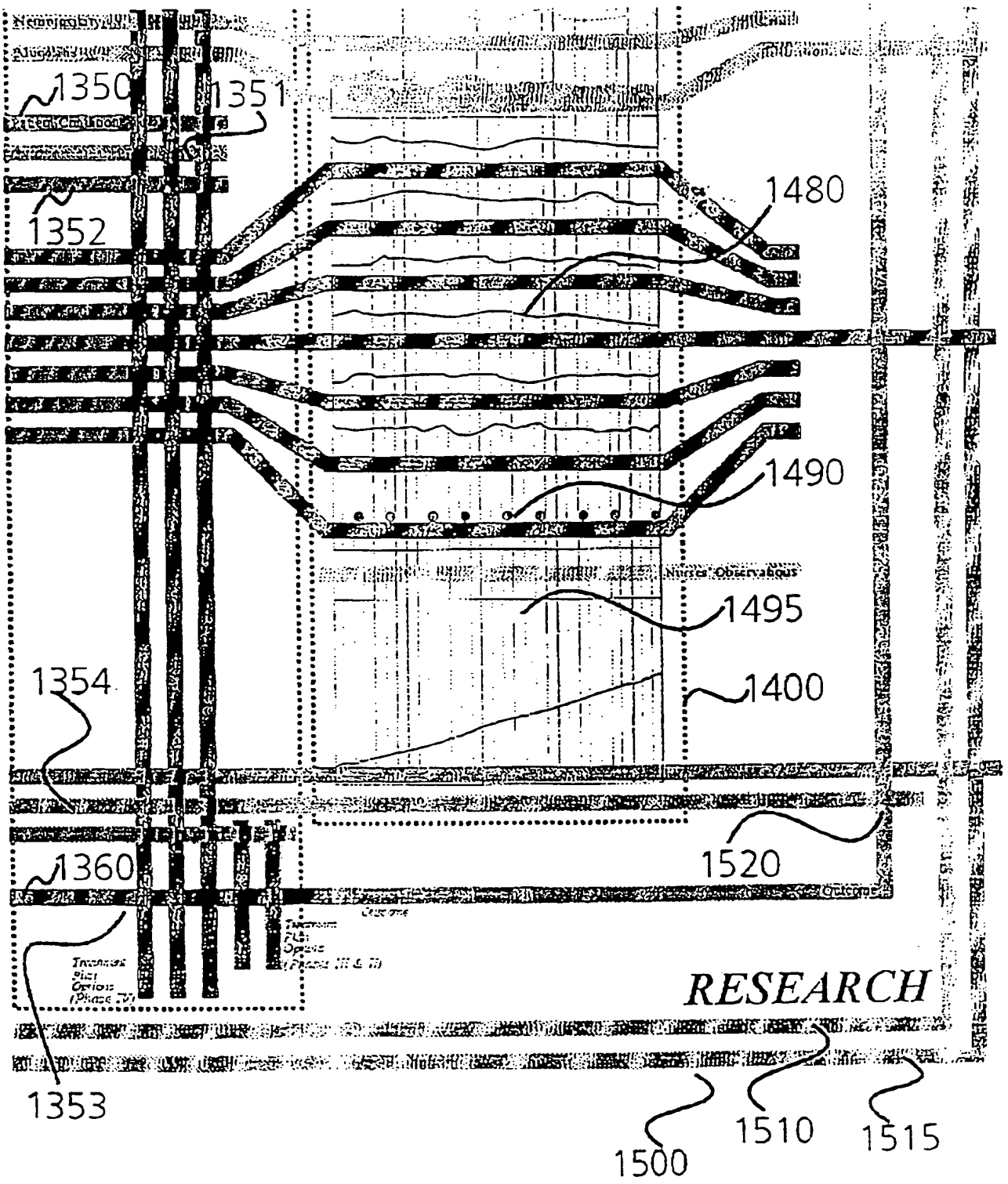
1350
1351
1352
1480
1490
1495
1354
1400
1520
1360
RESEARCH
1353
1500
1510
1515

Fig. 9

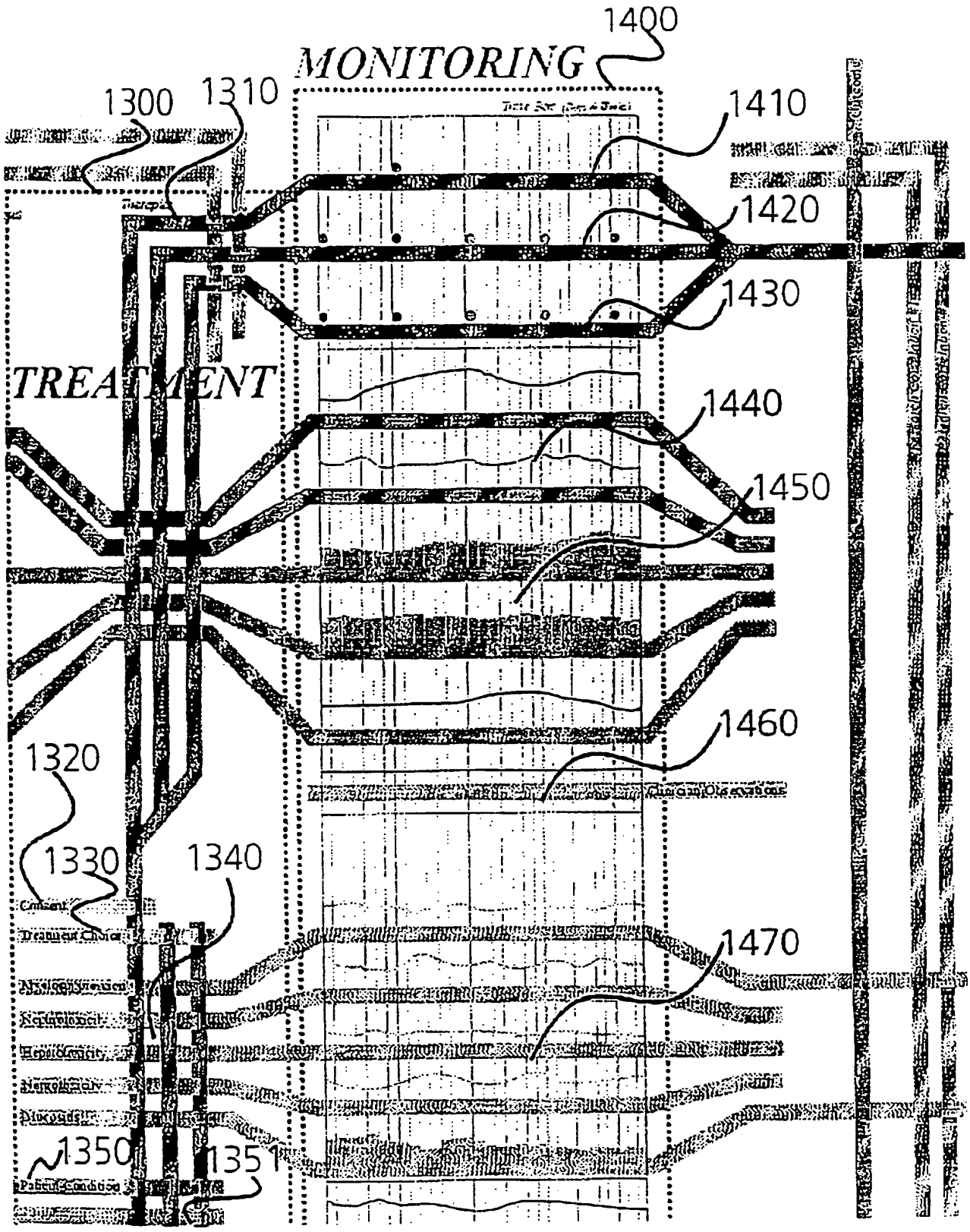
1400
MONITORING
1300
1310
1410
1420
1430
TREATMENT
1440
1450
1460
1320
1330
1340
1470
1350
1351

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 99/00103

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: G06F 17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: AS ABOVE AND G06F 3/00, 19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent WPAT, USPTO, IBM
keywords: database, data, GUI, display, information, weave, ribbon.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5623418 (Rostoker et al.) 22 April 1997	1 to 24
A	US 5544352 (Egger) 6 August 1996	1 to 24
A	US 4672683 (Matsueda) 9 June 1987	1 to 24

☐ Further documents are listed in the continuation of Box C

☐ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 November 1999	-7 DEC 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **P. CLAYTON-STAMM** Telephone No.: (02) 6283 2168